

## ABSTRACT

A method for analog representation of the amplitudes of a vector in which a set of single-stranded nucleic acid oligomers  $E_i$  and  $\underline{E}_i$  represents each m-component vector  $\mathbf{v} = \sum_i V_i \mathbf{e}_i$ , where  $E_i$  and  $\underline{E}_i$  are each in 1:1 correspondence with the basis vectors  $\mathbf{e}_i$ ,  $i=1,2,\dots,m$  in an abstract m-dimensional vector space. The  $E_i$  and  $\underline{E}_i$  oligomers have complementary sequences, and represent the i-th component of  $\mathbf{v}$  for which the amplitude  $V_i$  is positive and negative, respectively. The concentration of each of the oligomers  $E_i$  or  $\underline{E}_i$  is proportional to the magnitude of the amplitude  $V_i$  of the i-th component of  $\mathbf{v}$ . The oligomers independently comprise subunits selected from the group consisting of deoxyribonucleotides, ribonucleotides, and analogs of deoxyribonucleotides or ribonucleotides, and any single oligomer can comprise one, or a combination of two or more, of said different types of subunits. The invention also includes methods for analog representation of the operations of vector addition and vector and matrix algebra that are implemented using vectors that are represented by sets of oligomers  $E_i$  and  $\underline{E}_i$  as described above. The invention further includes a method for implementing an analog neural network, for which the data of each neuronal unit is represented by a set of oligomers  $E_i$  and  $\underline{E}_i$  as described above; and interconnections and signaling between neuronal units are represented by sets of biochemical reactions that are analog representations of operations of vector and matrix algebra as described above. Application of a saturating function to a signal from one or more neuronal units to produce an output is represented by hybridizing a set of oligomers selected by such a set of biochemical reactions to a complete, sub-stoichiometric set of single-stranded  $E_i$  and  $\underline{E}_i$  oligomers, and an output of the neural network is represented by a set of oligomers that specifically hybridize to such a sub-stoichiometric set of  $E_i$  and  $\underline{E}_i$  oligomers.